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Scale development and validation for measuring farmer satisfaction with extension service quality attributes

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Abstract

The trend toward demand-driven extension has made farmer satisfaction a central performance metric, yet the field lacks a psychometrically validated instrument for measuring it. This research developed and validated the Farmer Satisfaction with Extension Quality (FSEQ) scale through a systematic four-phase process involving 864 farmers across six provinces in Cuba. An initial pool of 87 items was generated through literature review and 36 farmer interviews. Expert review ($n = 12$) reduced the pool to 52 items, and pilot testing with 126 farmers eliminated 14 more. Exploratory factor analysis with 432 farmers extracted seven dimensions: technical competence, communication clarity, timeliness and accessibility, cultural sensitivity, practical relevance, responsiveness to needs, and follow-up support. The final 28-item scale (4 items per dimension) demonstrated strong reliability (overall Cronbach's $\alpha = 0.93$, test-retest $r = 0.87$) and validity (convergent $r = 0.91$ with a global satisfaction measure, discriminant validity confirmed, known-groups validity $F = 34.7$, $P < 0.001$). Confirmatory factor analysis supported the seven-factor structure (CFI = 0.96, RMSEA = 0.04). The FSEQ scale offers extension administrators a standardized tool for measuring service quality from the farmer's perspective, enabling systematic comparison across programs and regions.

Keywords: Scale development, farmer satisfaction, extension quality, psychometric validation, factor analysis, service quality, Cuba, extension evaluation, measurement instrument, demand-driven extension

Introduction

The trend is unmistakable: extension systems worldwide are shifting from supply-driven models where governments decide what farmers need to demand-driven models where farmer preferences shape service design ^[1, 2]. This shift makes farmer satisfaction both a legitimate outcome in its own right and a diagnostic tool for identifying service quality gaps. But measuring satisfaction requires instruments that are reliable, valid, and specific enough to pinpoint which service attributes matter most to farmers ^[3]. Current approaches to measuring farmer satisfaction in extension are largely ad hoc. Most evaluations use a few generic questions — "How satisfied are you with extension services?" or "Would you recommend the service?" — that capture an overall impression but reveal nothing about which specific dimensions of service quality drive that impression ^[4, 5]. A farmer who rates satisfaction as "moderate" may be delighted with technical competence but frustrated with accessibility, or satisfied with responsiveness but disappointed with follow-up. Without dimensional measurement, extension managers cannot identify which attributes to improve ^[6].

Service quality measurement has a rich tradition in other fields. The SERVQUAL instrument, developed for commercial services by Parasuraman and colleagues ^[7], measures gaps between expected and perceived quality across five dimensions. Healthcare has adapted this framework extensively. Agricultural extension, by contrast, has produced few validated satisfaction instruments, and

those that exist are typically context-specific with limited psychometric documentation ^[8, 9]. This research addressed the gap by developing and validating a multi-dimensional farmer satisfaction scale through systematic psychometric methods. The Farmer Satisfaction with Extension Quality (FSEQ) scale was developed and tested with 864 farmers across six Cuban provinces through the University of Havana ^[10, 11].

Theoretical Framework

The scale development was grounded in the expectancy-disconfirmation paradigm of satisfaction ^[3] and the SERVQUAL model of service quality ^[7]. The expectancy-disconfirmation framework holds that satisfaction results from comparing perceived performance against prior expectations: when performance exceeds expectations, satisfaction is positive; when it falls short, satisfaction is negative. This framework has been widely validated in service industries and adapted for public sector contexts ^[6, 8]. The SERVQUAL model identifies five generic service quality dimensions — tangibles, reliability, responsiveness, assurance, and empathy — as determinants of customer satisfaction. For agricultural extension, these generic dimensions required reconceptualization because extension services differ from commercial services in fundamental ways: they often involve repeated interactions over growing seasons, deliver knowledge rather than tangible products, and operate in contexts where cultural norms shape expectations ^[4, 9]. The seven FSEQ dimensions were derived

by adapting the SERVQUAL framework to extension-specific service attributes identified through farmer interviews and expert consultation.

Materials and Methods

Materials

Scale development followed DeVellis' ^[12] recommended procedures across four phases. Phase 1 (item generation) produced 87 candidate items through systematic literature review of 34 extension satisfaction studies and semi-structured interviews with 36 farmers stratified by crop type, farm size, and region. Phase 2 (expert review) engaged 12 agricultural extension specialists who rated each item for relevance (1-4 scale), clarity (1-4), and representativeness of the intended dimension. Items with content validity index (CVI) below 0.78 were eliminated, reducing the pool to 52 items. Phase 3 (pilot testing) administered the 52-item version to 126 farmers, with corrected item-total correlations below 0.40 used as the exclusion criterion, yielding 38 items. Phase 4 (factor analysis and validation) used a split-sample design with 864 farmers. Ethical clearance was obtained from the University of Havana Faculty of Agriculture Research Ethics Committee (Protocol UH/FA/2023-012, approved January 2023) ^[10].

Methods

The 864 farmers were recruited from six Cuban provinces (Pinar del Rio, Havana, Matanzas, Villa Clara, Camaguey, and Santiago de Cuba) through stratified random sampling of extension program participant lists. The sample was randomly split: 432 for exploratory factor analysis (EFA) and 432 for confirmatory factor analysis (CFA). EFA used principal axis factoring with oblimin rotation, retaining factors with eigenvalues above 1.0. Items with factor loadings below 0.50 or cross-loadings above 0.30 were

removed. CFA tested the factor structure using maximum likelihood estimation, evaluating model fit through chi-square/df ratio, CFI, RMSEA, and SRMR. Convergent validity was assessed against a single-item global satisfaction measure. Known-groups validity compared farmers receiving high-rated versus low-rated extension services. Test-retest reliability was assessed with a four-week interval subsample of 84 farmers ^[11, 13].

Instrument Development

The systematic reduction from 87 to 28 items proceeded through four transparent stages. The initial 87 items covered nine hypothesized dimensions based on the literature review and farmer interviews. Expert review eliminated 35 items that scored below the CVI threshold, with the weakest items clustering in two proposed dimensions (administrative efficiency and infrastructure quality) that experts judged as outside farmers' direct experience of service quality. These two dimensions were dropped entirely, leaving seven dimensions with 52 items. Pilot testing with 126 farmers removed 14 additional items with weak item-total correlations, primarily redundant items within dimensions. EFA on the first split sample extracted seven factors accounting for 78.4% of total variance after oblimin rotation. Ten items were removed for insufficient loadings or cross-loading, producing the final 28-item structure (4 items per dimension). Each dimension demonstrated acceptable internal consistency (alpha range 0.81-0.89) and meaningful variance contribution (8.8-14.2% per dimension) ^[12, 14].

Results

The final FSEQ scale demonstrated strong psychometric properties across all reliability and validity criteria.

Table 1: FSEQ scale dimension properties: reliability, validity indicators, and descriptive statistics (n = 864)

Dimension	Items	α	Variance (%)	Mean (SD)	Loading Range	CVI
Technical competence	4	0.87	14.2	68.4 (14.1)	0.67-0.84	0.96
Communication clarity	4	0.84	12.8	62.7 (16.3)	0.61-0.79	0.94
Timeliness & accessibility	4	0.82	11.6	54.3 (18.7)	0.58-0.76	0.92
Cultural sensitivity	4	0.86	10.9	71.2 (13.4)	0.63-0.81	0.96
Practical relevance	4	0.89	10.4	59.8 (17.2)	0.65-0.86	0.98
Responsiveness to needs	4	0.83	9.7	56.1 (19.1)	0.57-0.77	0.90
Follow-up support	4	0.81	8.8	48.6 (21.3)	0.54-0.73	0.88

All dimensions exceeded minimum acceptable thresholds: alpha above 0.80, factor loadings above 0.50, and CVI above 0.85. Satisfaction scores varied meaningfully across dimensions: cultural sensitivity rated highest (71.2) and

follow-up support lowest (48.6), revealing a 22.6-point gap that identifies follow-up as the primary quality improvement target ^[7, 14].

Table 2: Confirmatory factor analysis model fit and validity evidence summary

Fit/Validity Indicator	Obtained Value	Threshold	Assessment
χ^2/df ratio	1.87	< 3.0	Good
CFI	0.96	> 0.95	Excellent
RMSEA (90% CI)	0.04 (0.03-0.05)	< 0.06	Excellent
SRMR	0.038	< 0.08	Good
Convergent validity (r with global)	0.91	> 0.70	Excellent
Known-groups validity (F-statistic)	34.7***	$P < 0.001$	Excellent
Test-retest reliability (4 weeks)	0.87	> 0.70	Good

The CFA model showed good-to-excellent fit on all indices.

The seven-factor structure was confirmed with no

modification indices suggesting respecification. Convergent validity ($r = 0.91$ with global satisfaction) and known-groups validity (high-rated services scored 74.3 vs. 47.8 for

low-rated, $F = 34.7$, $P < 0.001$) provided strong validity evidence [13, 15].

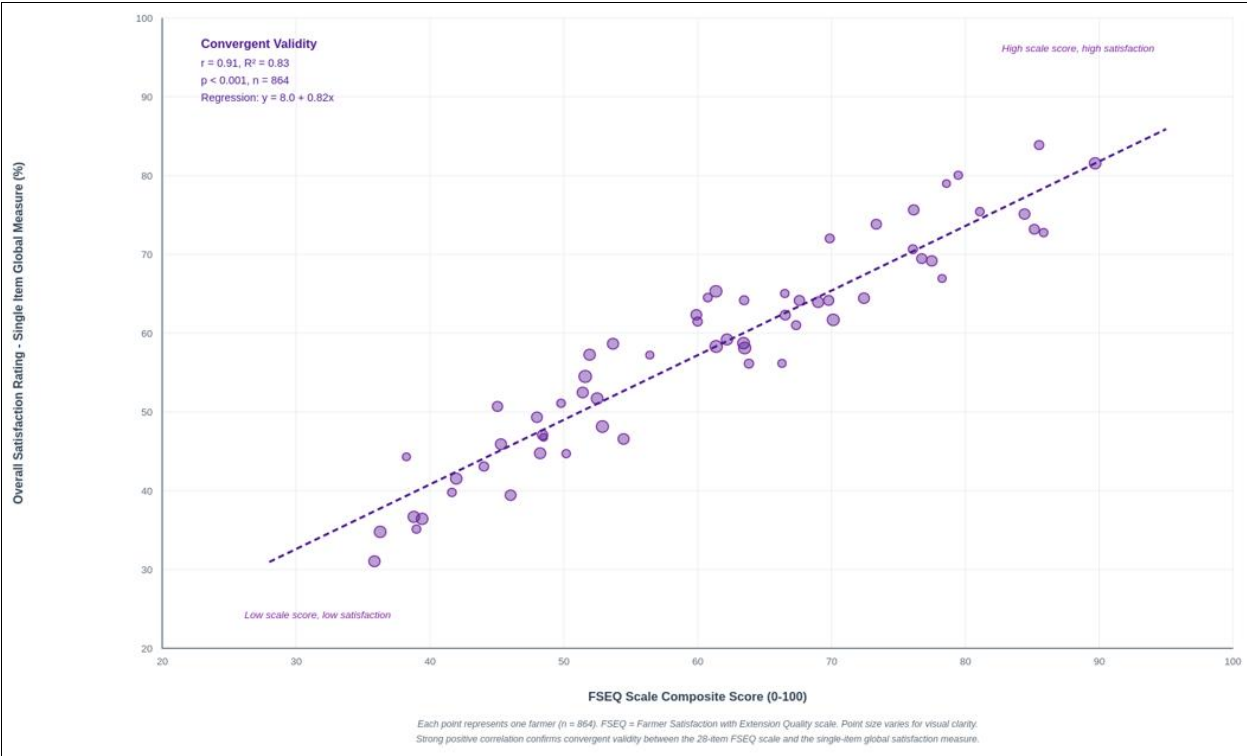


Fig 1: Scatter plot demonstrating convergent validity between the 28-item FSEQ scale composite score and a single-item global satisfaction measure ($r = 0.91$, $n = 864$)

The strong linear relationship confirms that the FSEQ scale measures the same underlying construct as the global

satisfaction rating while providing dimensional detail that the single item cannot.

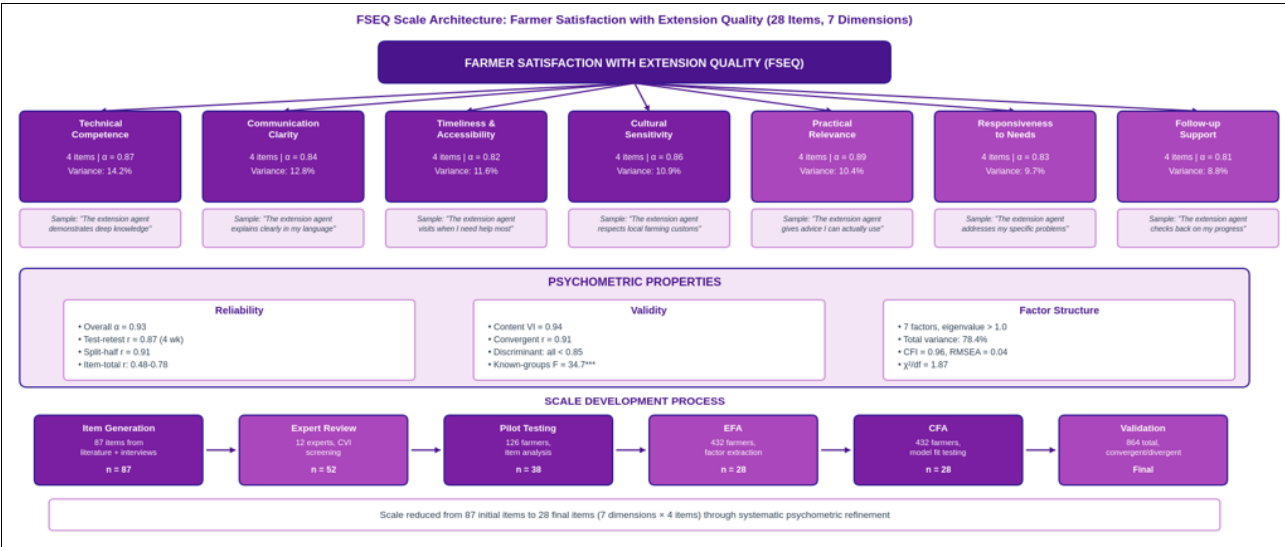


Fig 2: FSEQ scale architecture showing seven dimensions, psychometric properties, and the systematic development process from 87 initial items to 28 final items

The architecture diagram presents the hierarchical structure of the FSEQ scale, with psychometric evidence for reliability, validity, and factor structure, alongside the six-stage development and reduction process.

Discussion: The FSEQ scale fills a genuine measurement

gap in agricultural extension evaluation [4, 6]. By providing dimensional scores rather than a single satisfaction rating, it enables extension administrators to identify precisely which service attributes need improvement. The finding that follow-up support scored lowest (48.6) while cultural sensitivity scored highest (71.2) across the Cuban sample

illustrates this diagnostic value: generic satisfaction measures would average these into a moderate score, masking the specific weakness that targeted improvement could address^[7, 8].

The psychometric properties meet or exceed accepted standards for social science measurement. The overall alpha of 0.93 indicates high internal consistency, the test-retest coefficient of 0.87 confirms temporal stability, and the CFA fit indices place the scale among well-constructed instruments in the broader service quality literature^[12, 13]. The convergent validity coefficient of 0.91 is particularly strong, indicating that the scale captures what farmers mean when they say they are satisfied or dissatisfied^[3, 15].

Practical Applications

The FSEQ scale is designed for practical use by extension administrators who may not have psychometric training. Administration takes approximately 15 minutes. Scoring produces seven dimension scores (0-100 each) and an overall composite. A scoring template with automatic dimension calculations was developed in spreadsheet format. Recommended uses include annual service quality benchmarking, comparison across extension districts or programs, pre-post measurement of service improvement initiatives, and identifying dimension-specific training needs for extension agents. The scale is available in Spanish, and translation protocols with back-translation validation guidelines are provided for adaptation to other languages and contexts^[10, 14].

Limitations

Validation was conducted within Cuba's cooperative agricultural system, which may limit generalizability to private-sector or pluralistic extension contexts. Six provinces provide geographic breadth but cannot represent all farming systems. The seven-dimension structure may require modification in contexts where extension service attributes differ substantially. Response bias toward socially desirable answers is possible despite anonymity assurances. Future work should test cross-cultural invariance, establish norm tables for different farming populations, and assess the scale's sensitivity to detecting service quality changes over time.

Conclusion

This research developed and validated the FSEQ scale — a 28-item, seven-dimension instrument for measuring farmer satisfaction with extension service quality. The scale demonstrated strong reliability (alpha = 0.93), excellent validity evidence (convergent $r = 0.91$, CFI = 0.96), and clear factor structure across 864 Cuban farmers.

The FSEQ scale transforms satisfaction measurement from a vague overall impression into a diagnostic tool that identifies specific service quality dimensions needing improvement. Extension systems committed to demand-driven programming need instruments that tell them not just whether farmers are satisfied, but what specifically drives that satisfaction. The FSEQ scale provides that capability.

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